プロシージャルモデリングを利用した車のカスタムパーツ生成について

2022年8月23日　㈱ポリフォニー・デジタル　飯塚 渉

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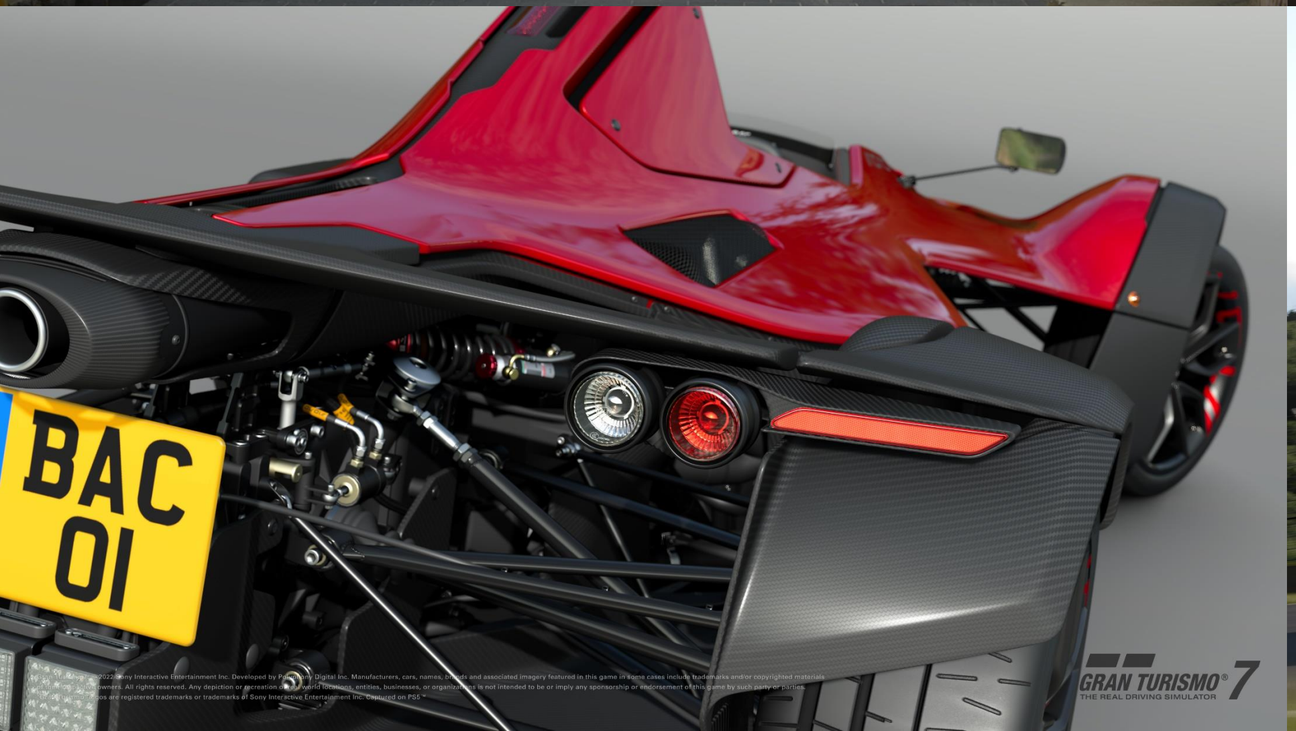

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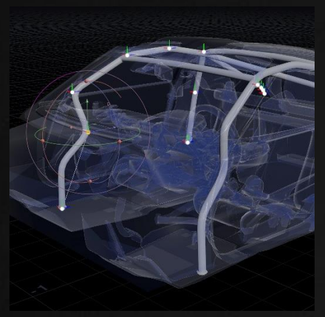
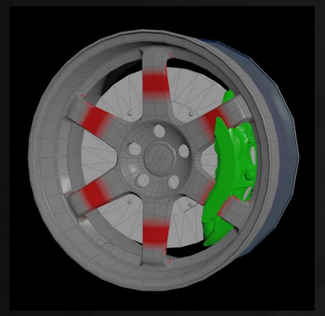
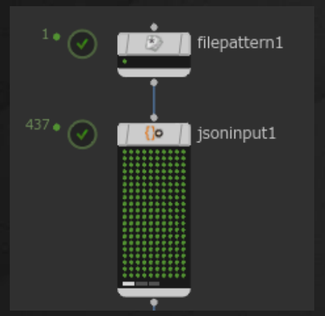
紹介する事例



- プロシージャルモデリング
  - ロールケージ
- プロトタイピング
  - ホイールデフォーマ
- デバッグ
  - 干渉チェック

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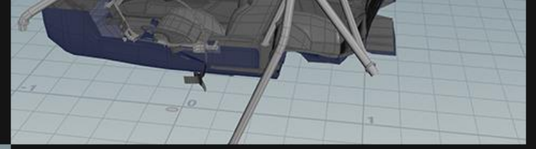
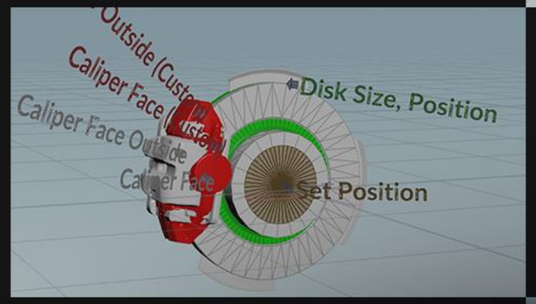
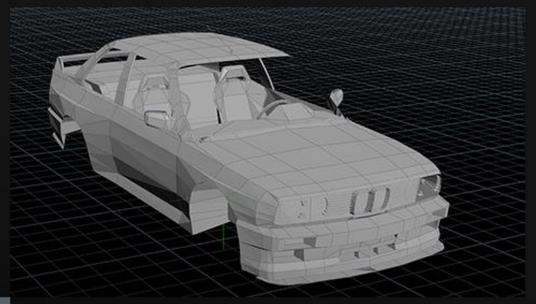
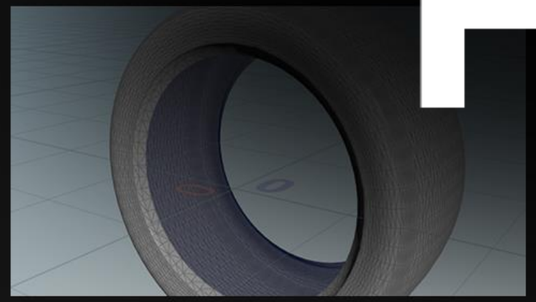
STATE OF PLAY
Over 400 types of cars

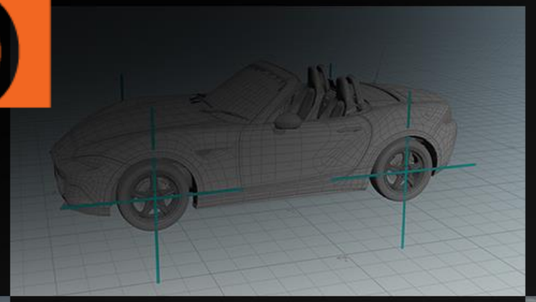


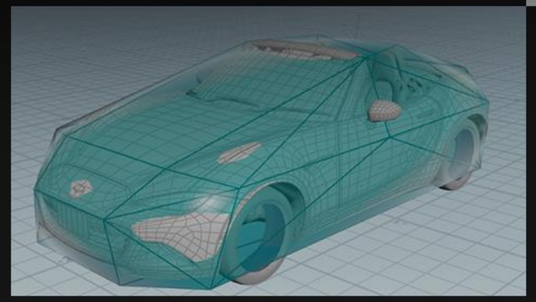


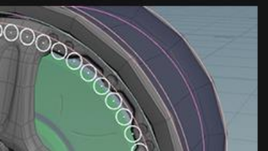


Houdini™

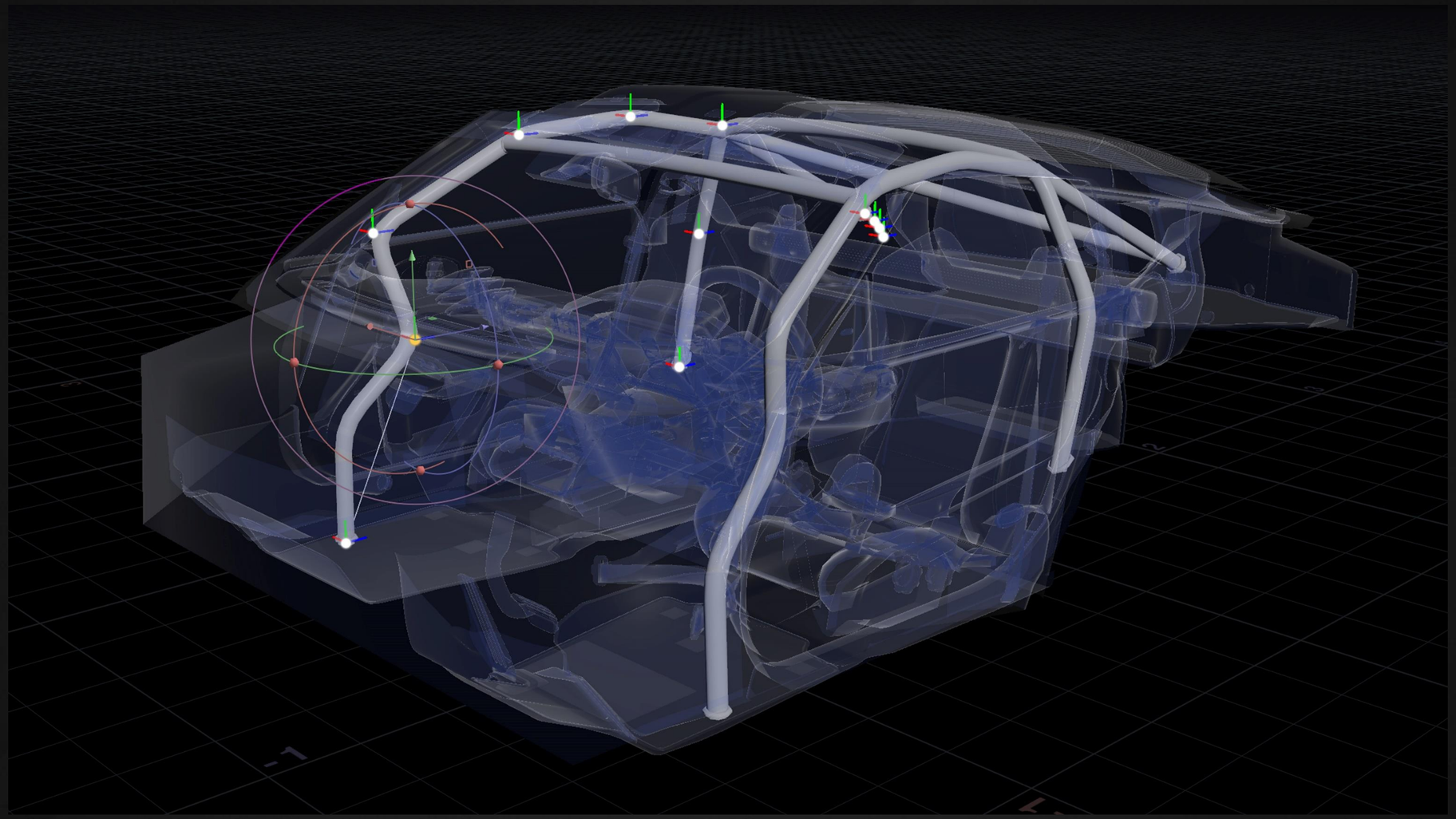








プロシージャルモデリング　ロールケージビルダ



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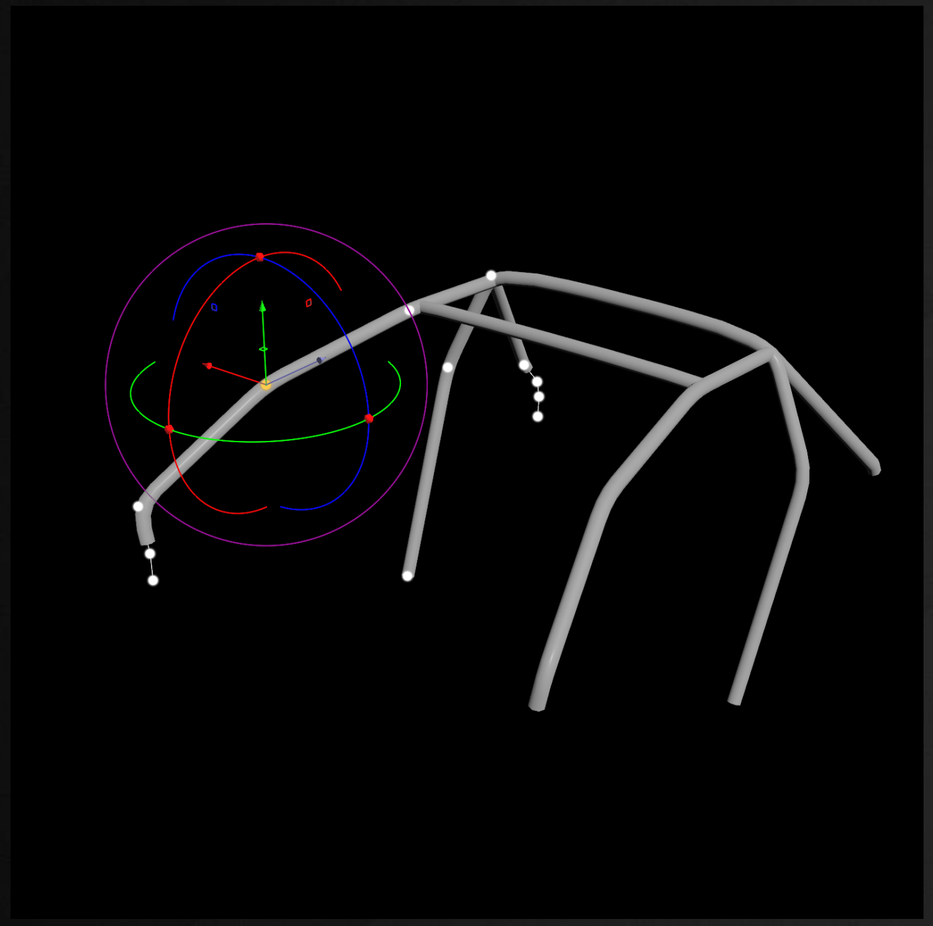
ロールケージとは

- 金属パイプのフレーム
- ボディ剛性を高める
- 競技車両に取り付けられる

基本となるジオメトリノード



- Sweep
  - レールと断面の2つの曲線からサーフェスを作成
- Rig Pose
  - ポリラインを調整する為に使用

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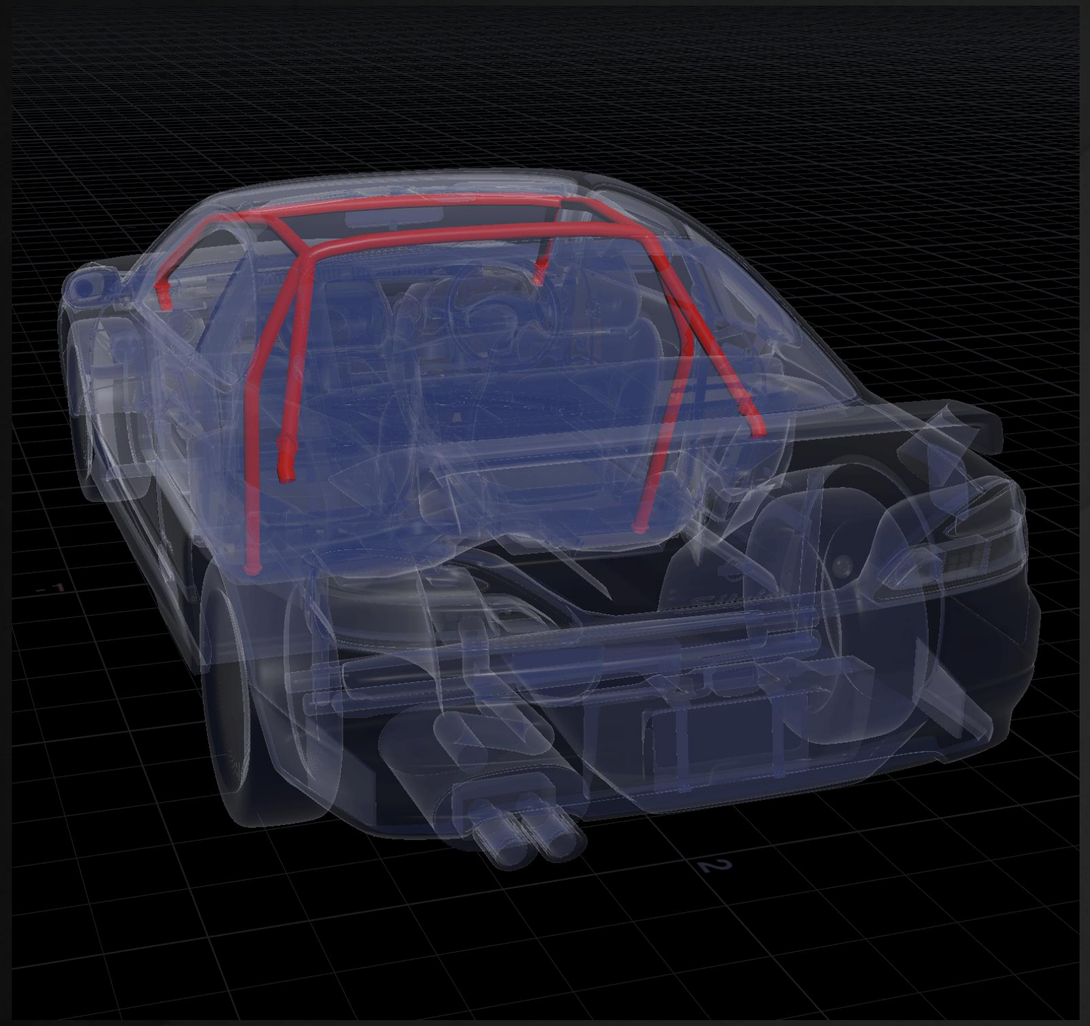
ツールとして完成させるために

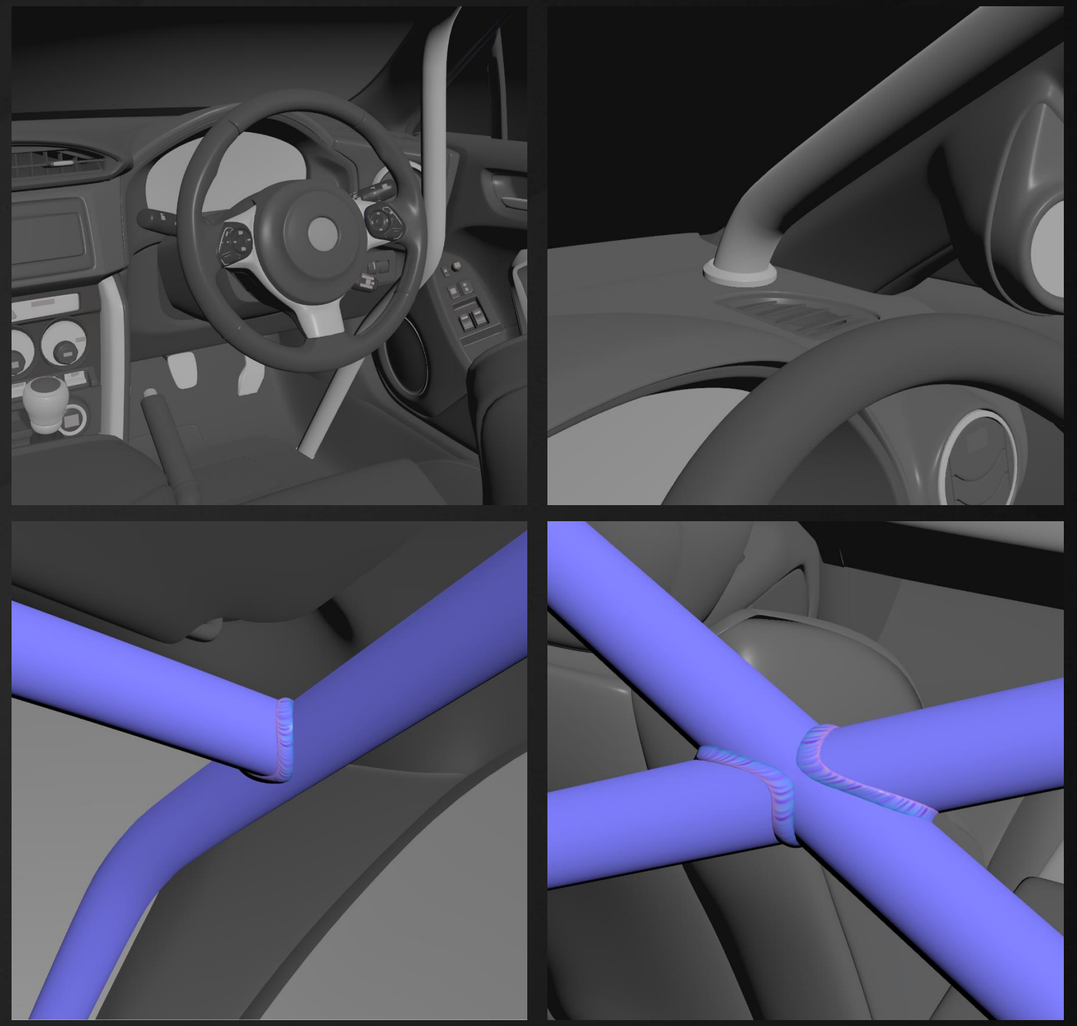
1. 現実的で説得力のあるデザインにブラッシュアップ
2. 必要な独自情報を持ったクルマモデルの参照
3. Houdiniで完結

1. 現実的で説得力のあるデザイン

- 理由
  - 現実に忠実なゲーム
  - 細部まで見ることができるゲームモード
- 解決法
  - 実物を取材、観察する
  - 専門家に話を伺う
  - インターネット、書籍を利用して情報を集める

ブラッシュアップ結果





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2. 必要な独自情報を持ったクルマモデルの参照

- 理由
  - モデリングはmayaで行っている
    追加モデルにはクルマの独自情報も必要
    FBXでは不十分だった
- 解決法
  - USDを採用
  - MayaからUSDで出力
    専用のエクスポーターを開発
  - Houdini　SOLARISで読み込み
    標準機能

参考

CEDEC 2017　ピクサー USD 入門 新たなコンテンツパイプラインを構築する
https://www.slideshare.net/takahitotejima/usd-79288174

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3. Houdiniで完結

- 理由
  - 修正が容易
  - コストを抑える
- 解決法
  - ゲームの仕様を全て含んで生成
  - USDで出力
  - プロシージャルシーングラフ

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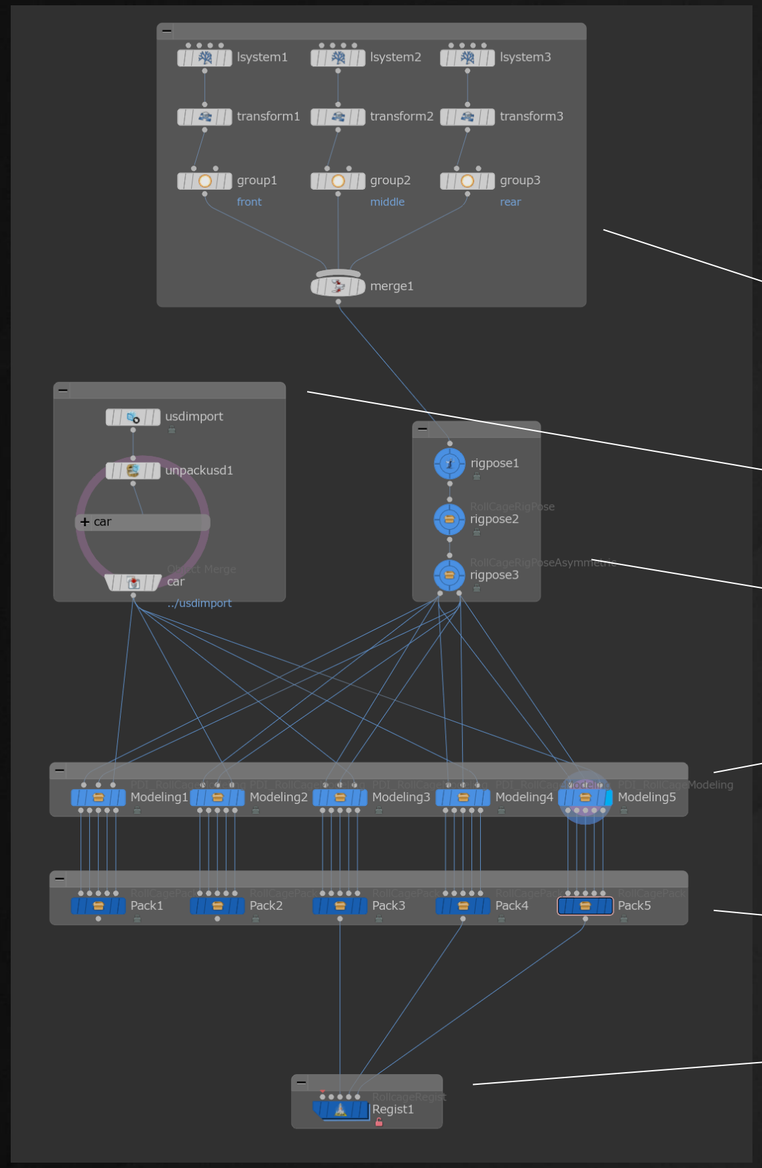
ツールの全体像



- クルマ毎にHIPファイルを分けて作業
  - カスタムに詳しいアーティストのみが扱う

① L-Systemでポリラインを生成
- クルマ毎に共通

② USDでクルマの読み込み

③ リグポーズでポリラインを調整

④ パイプを生成
- ディテールやLod等も同時に生成
- 複数バリエーションを用意

⑤ アトリビュートにシーングラフのパスを追加

⑥ 出力

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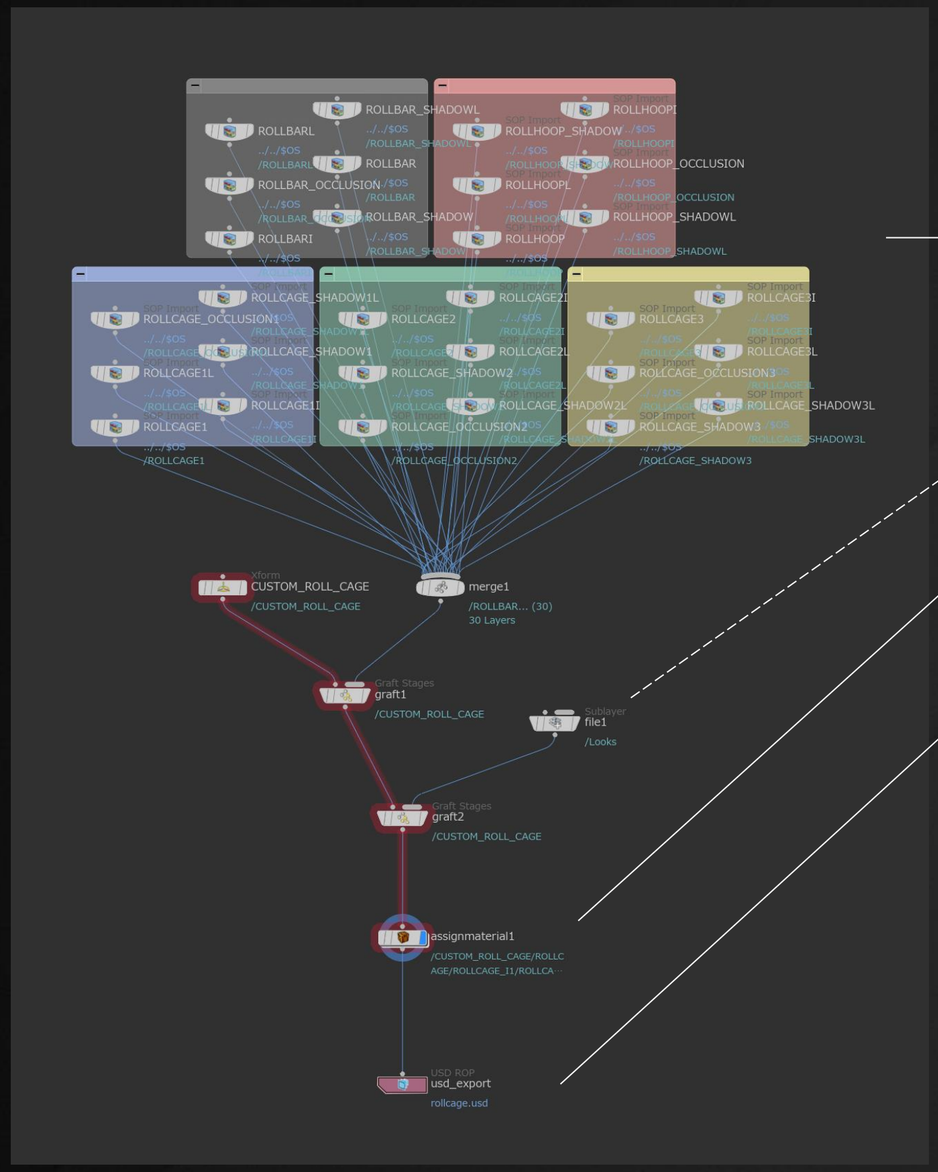
出力方法



- Lop Network
  - ① Graft で階層を作る
    シェーダはmayaからusdで出力
  - ② Assign Material
  - ③ USDで出力
    - ノードは標準機能
- 詳細
  - CEDEC2022『グランツーリスモ７』開発におけるUSD活用事例

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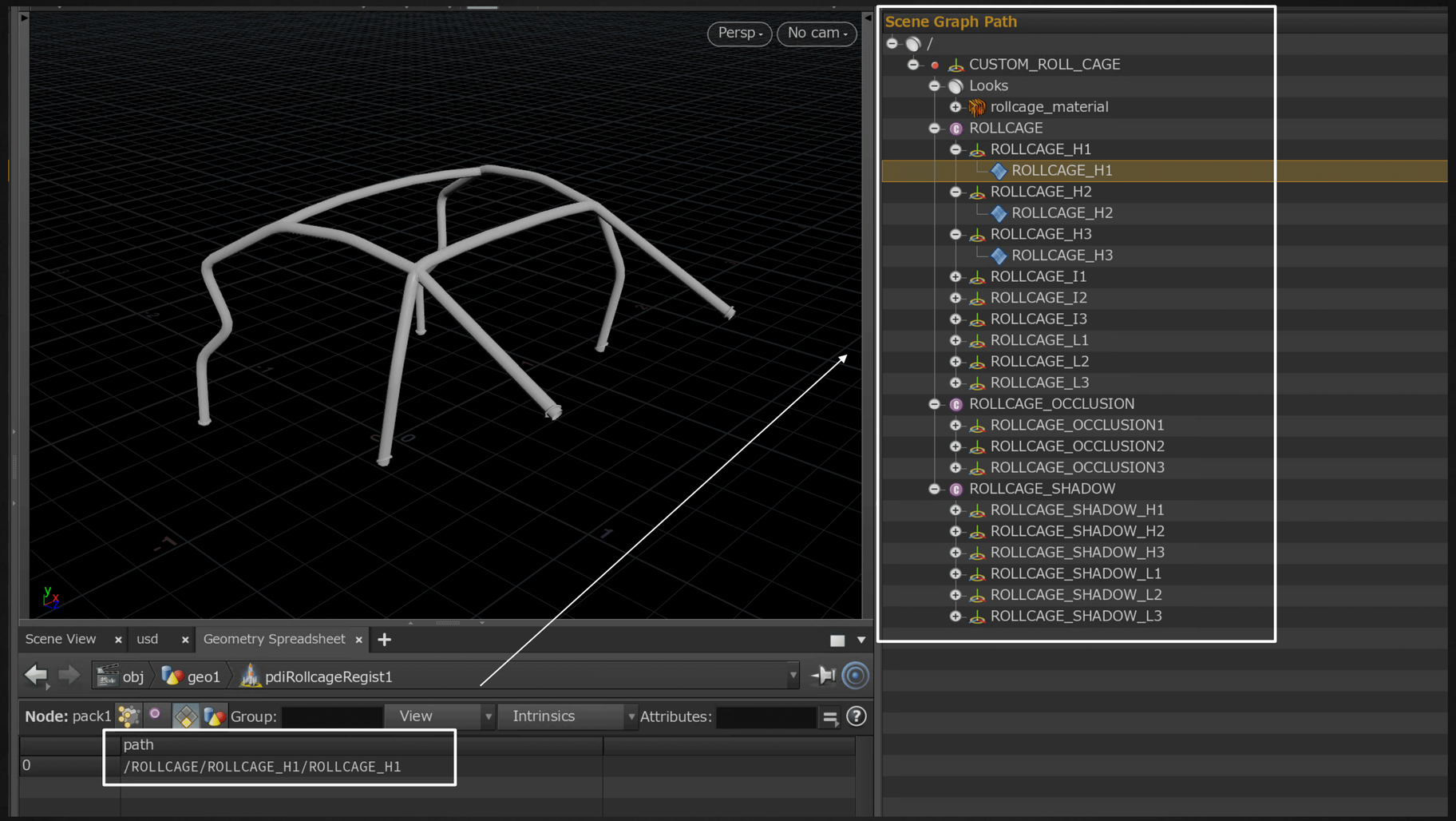
プロシージャルシーングラフ



モデリングの過程でシーングラフのパスをアトリビュートに追加しておくことで
SOLARISでのシーンの階層構造を自動的に構成できる

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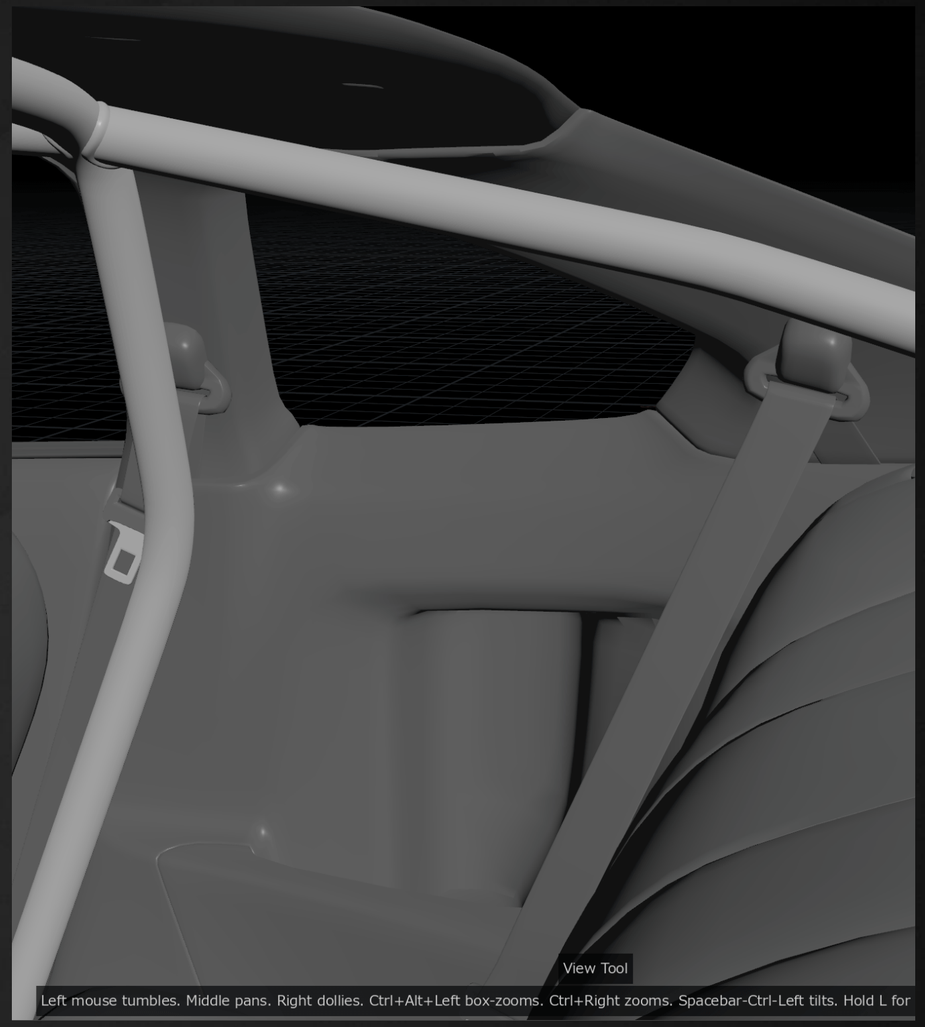
リグポーズを使った簡単な修正


View Tool
Left mouse tumbles. Middle pans. Right dollies. Ctrl+Alt+Left box-zooms. Ctrl+Right zooms. Spacebar-Ctrl-Left tilts. Hold L for

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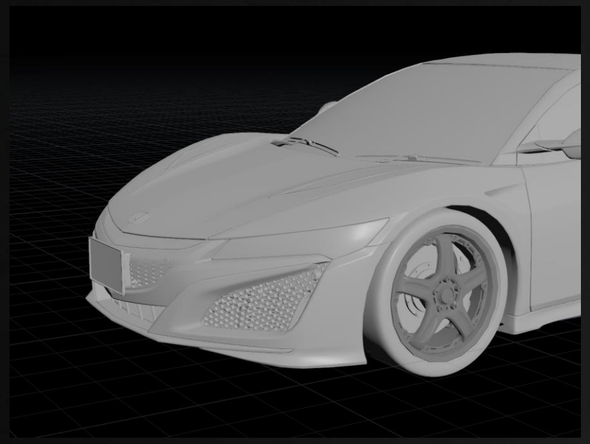
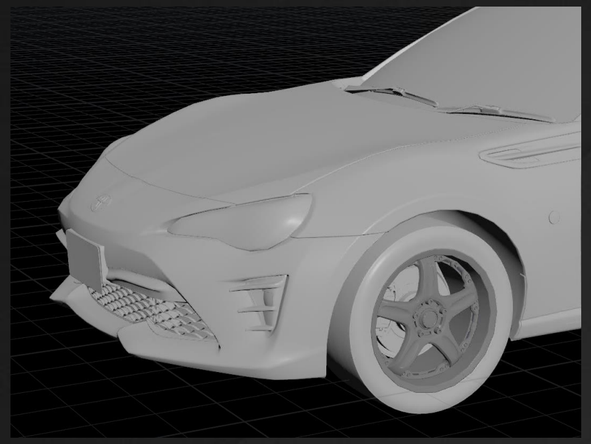
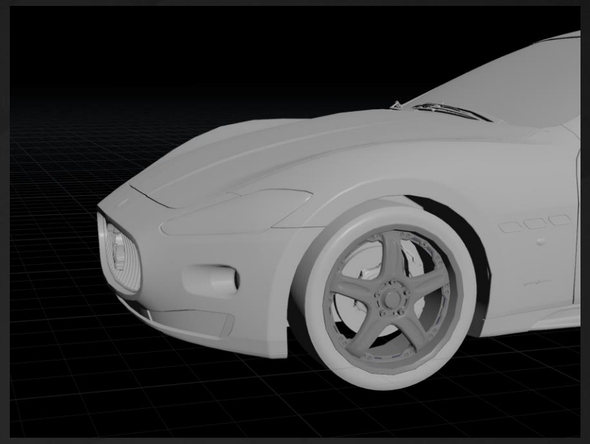
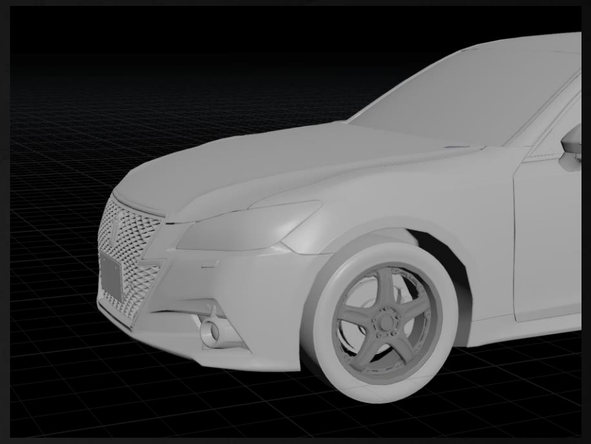
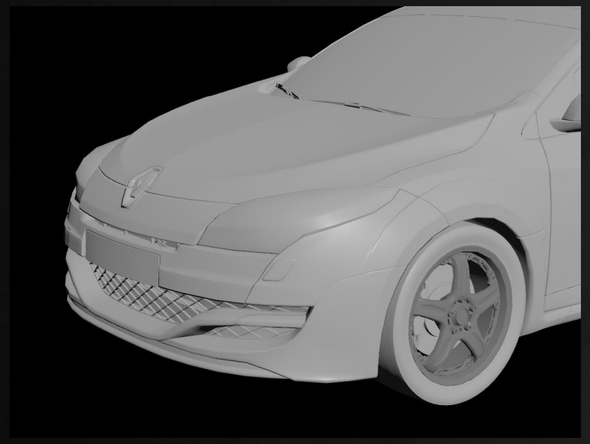

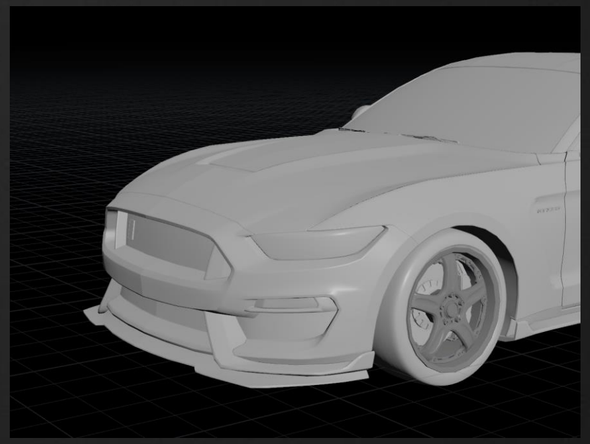
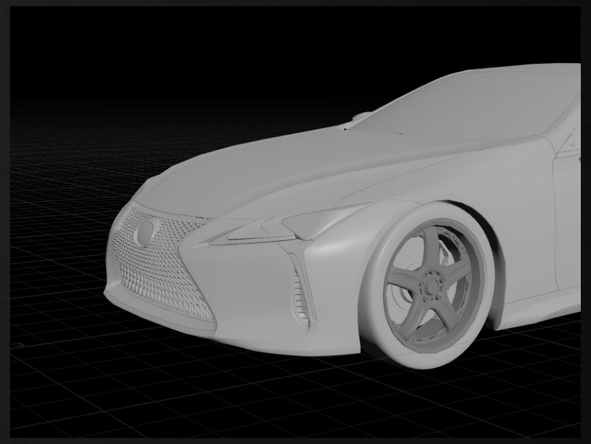

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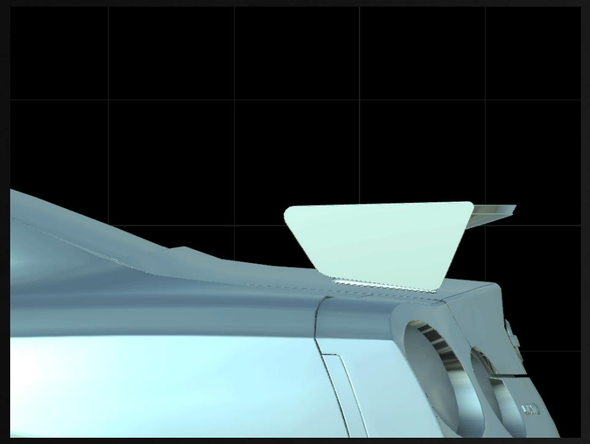
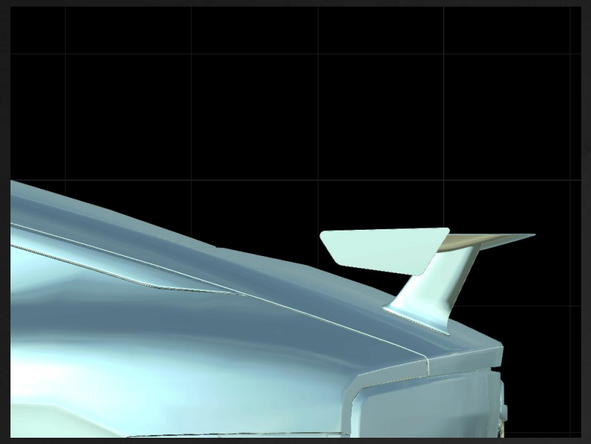
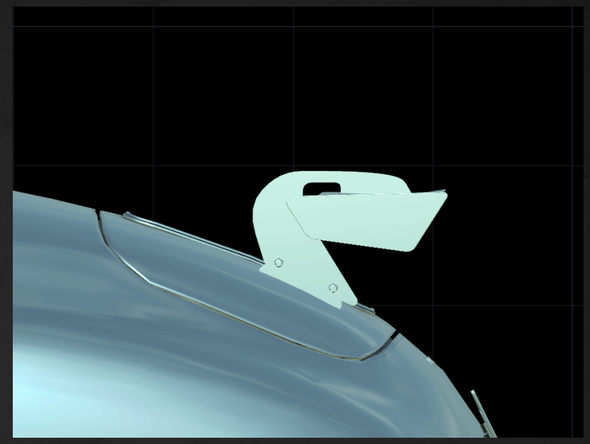
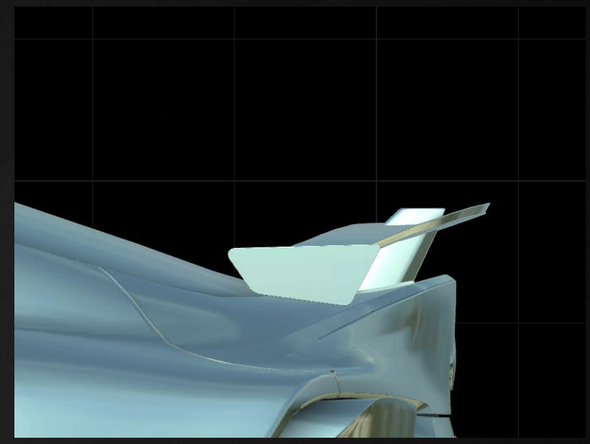
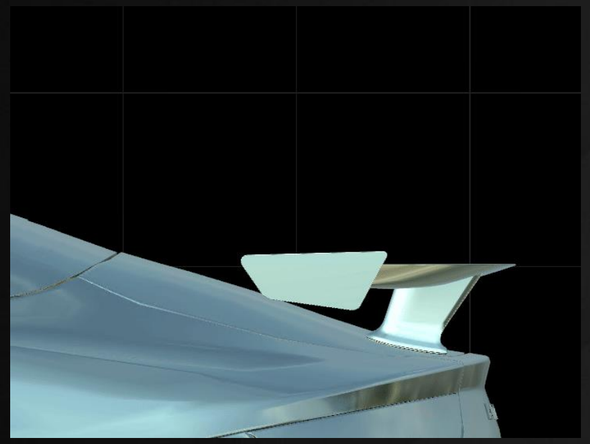
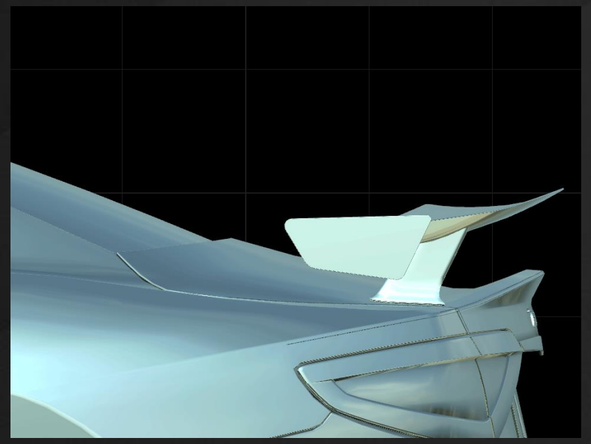
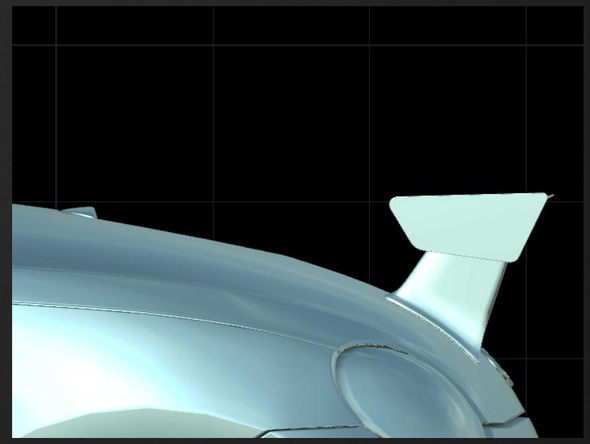
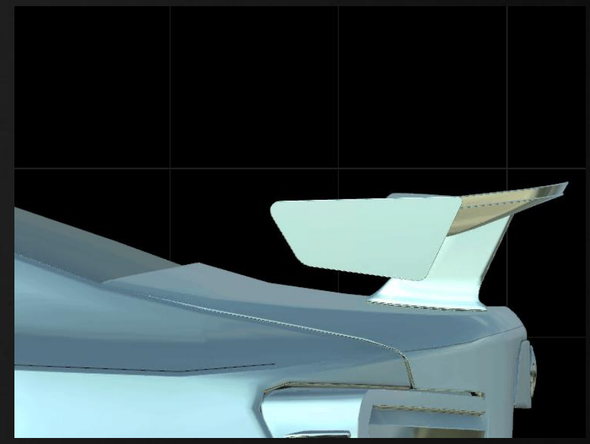

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プロトタイピング　ホイールデフォーマ

Over 400 types of cars × Over 130 types of wheels
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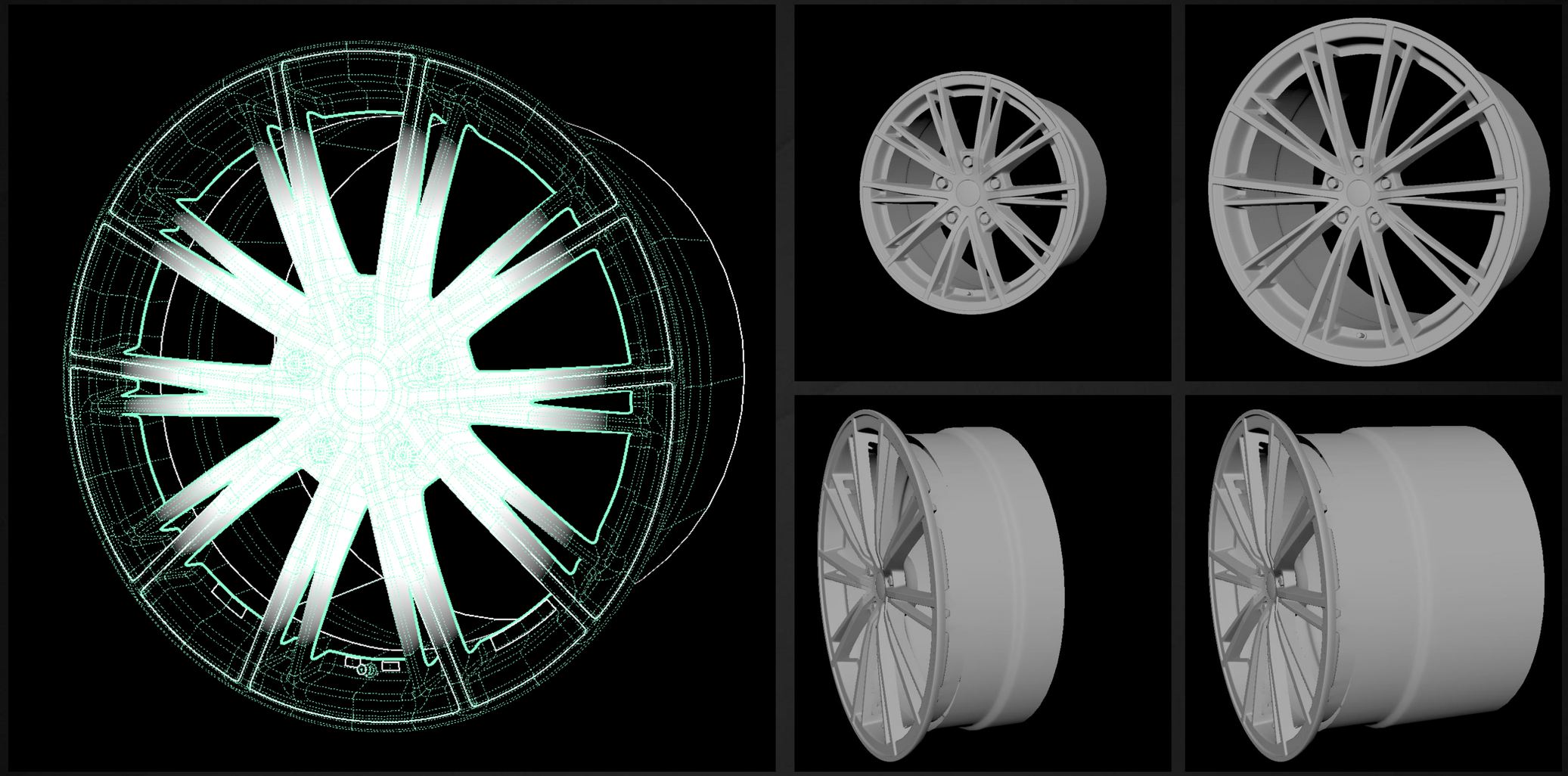
前作までの試み



スキンウェイトで変形

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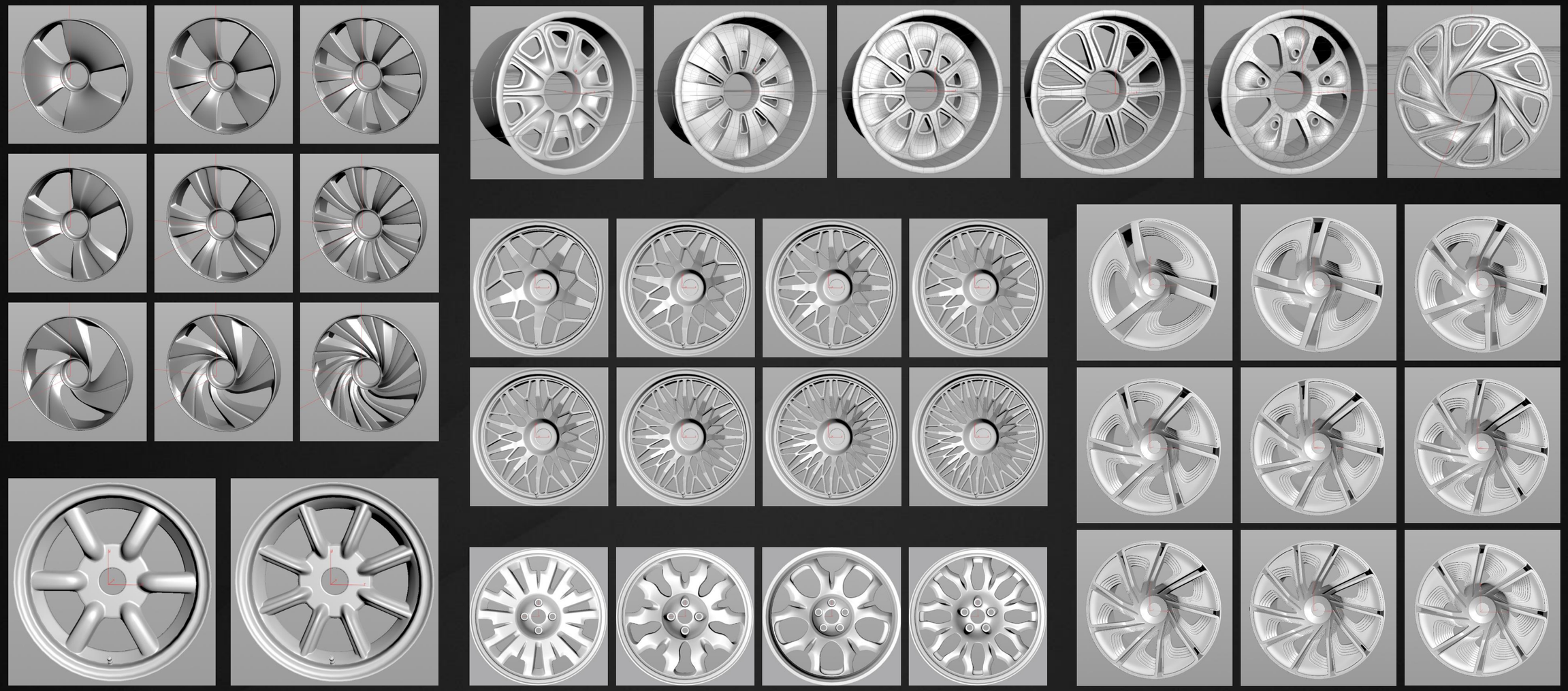
過去の事例



2013年頃のプロシージャルモデリング研究

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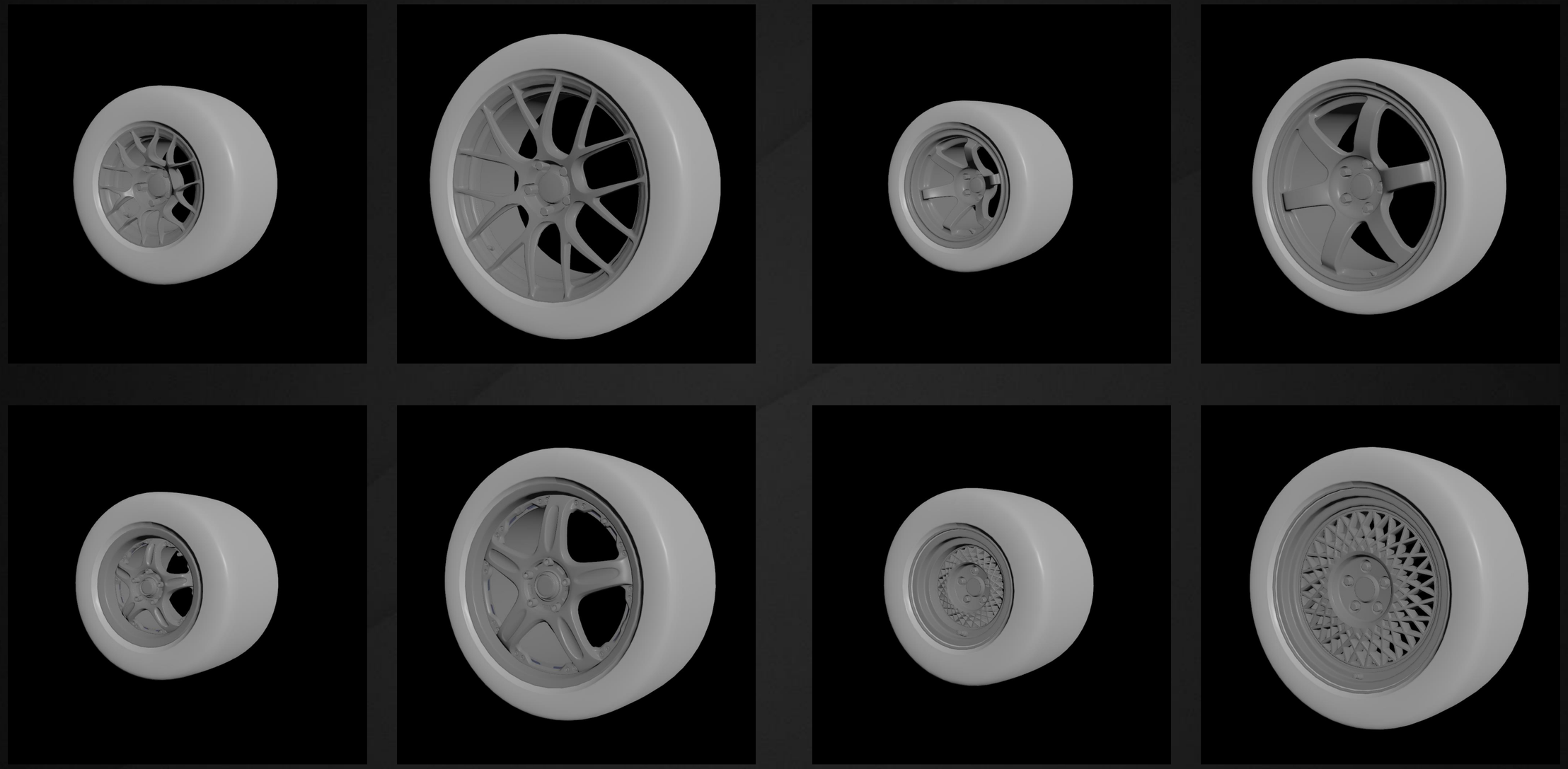
ホイールの変形をプロトタイピング（1）



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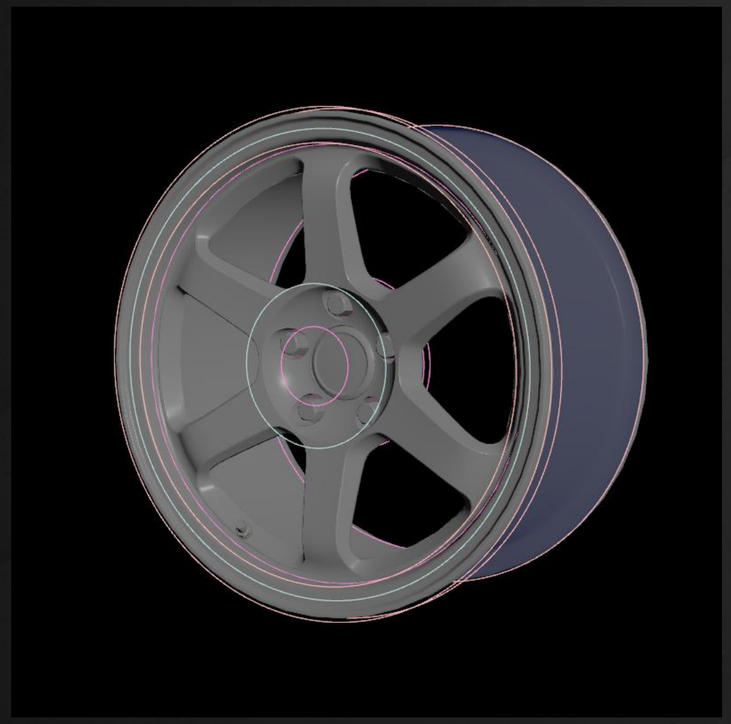
ホイールの変形をプロトタイピング（2）

- 特徴的な部位毎の変形を検証する為に範囲を指定
- 範囲毎の検証にはVEXを使用



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実機 で Houdini の変形を再現

アーティストが検証したVEXを参考に、エンジニアがコンピュートシェーダで実装

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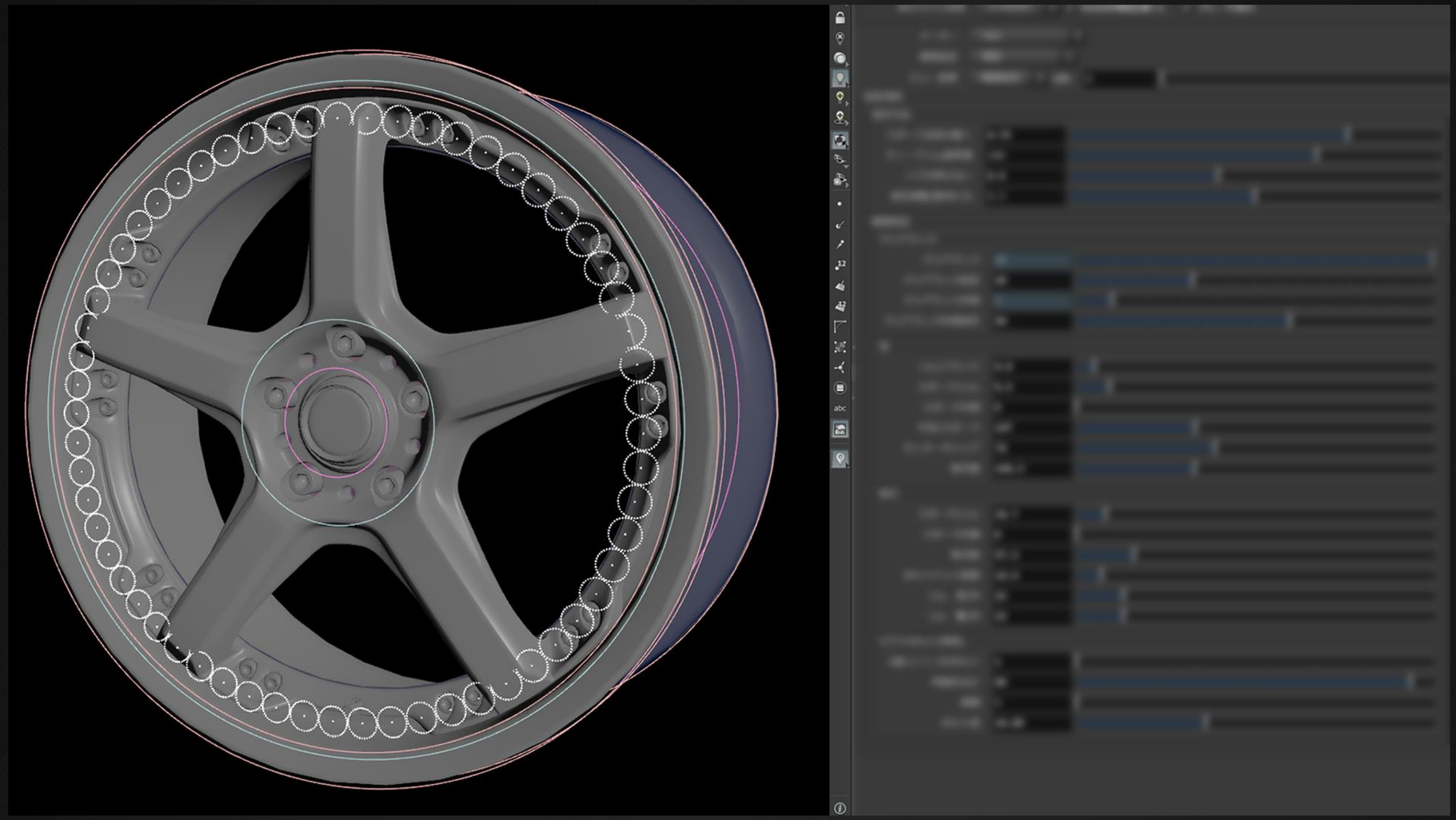
プロトタイピング後の活用先



ホイールの変形パラメータを設定するツールに流用

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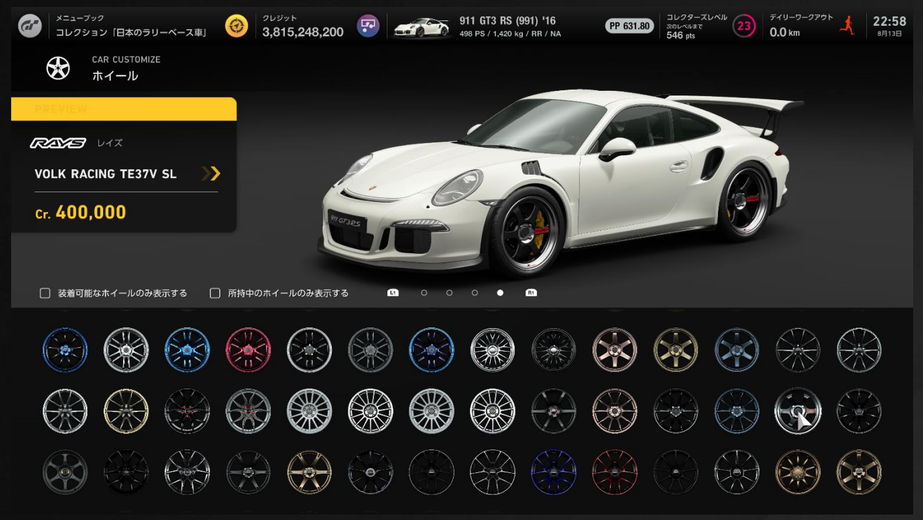
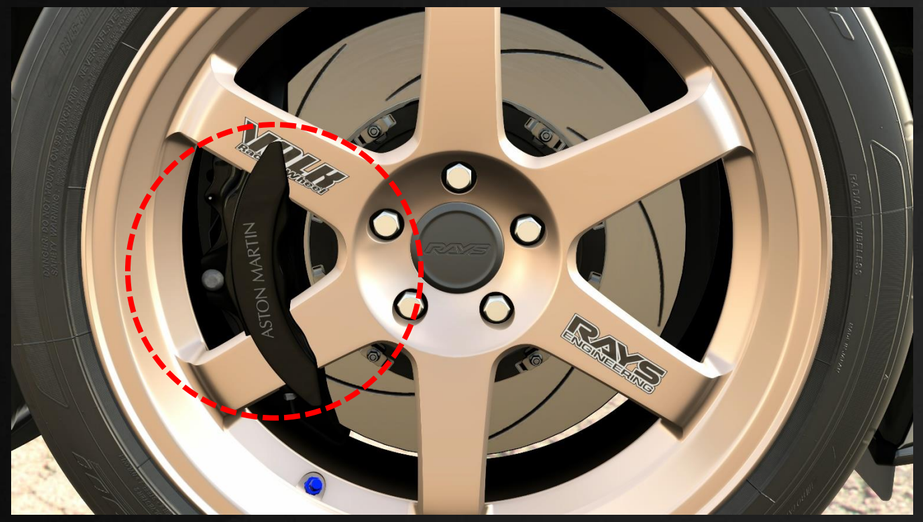
複雑な足回りの組み合わせ





- 組み合わせは多い車で4000パターン以上
  - 前輪、後輪
  - ブレーキ純正、カスタム
  - フェンダーのワイド化
  - リム径のインチアップ、ダウン
  - 多種多様なホイール
- ブレーキがホイールに干渉する事も

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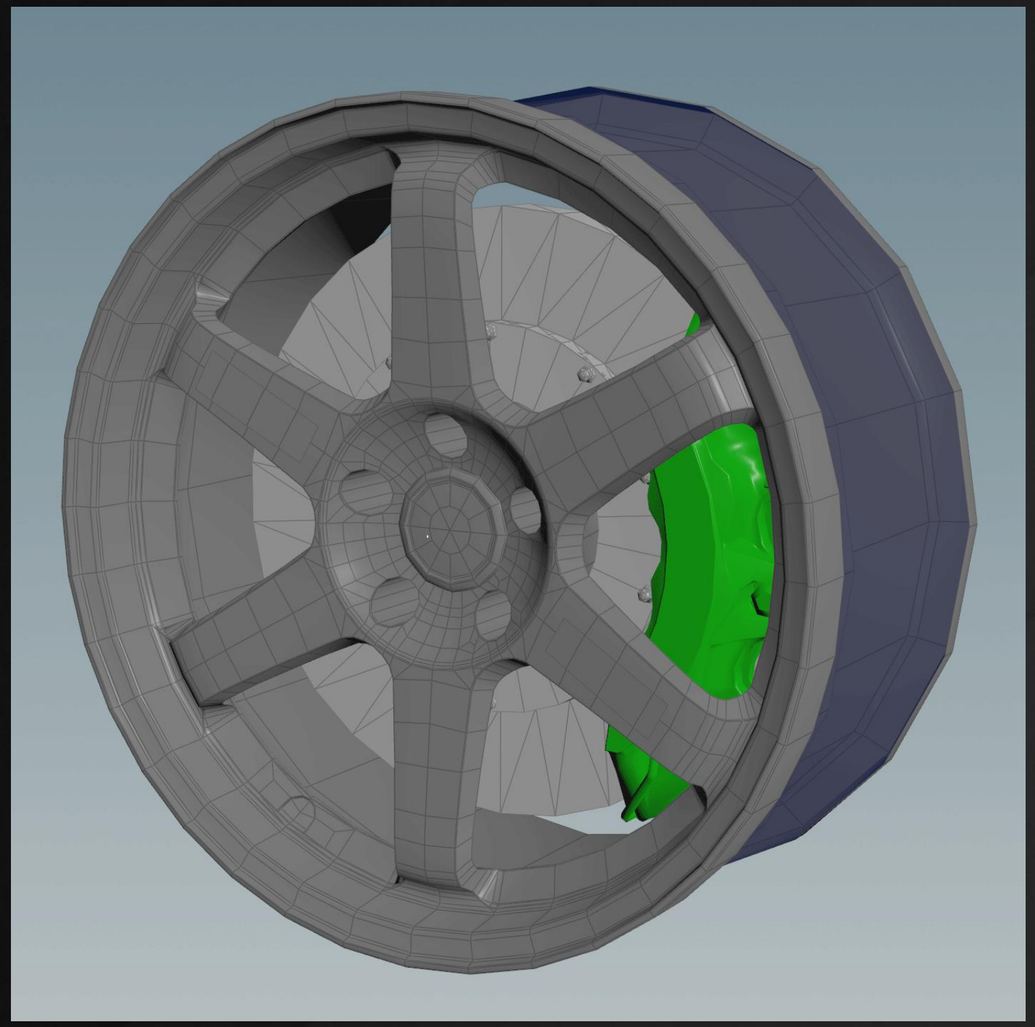
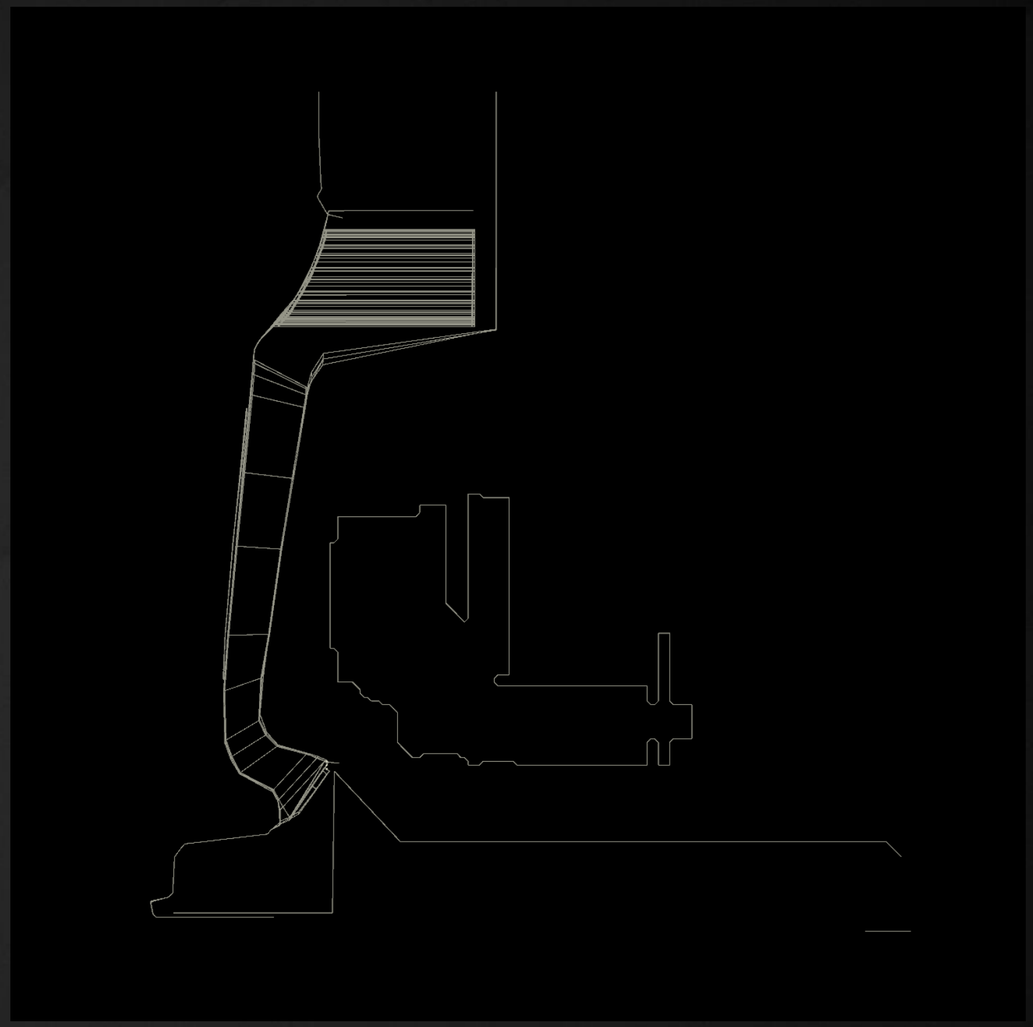
デバッグツール





全ての組み合わせをHoudiniで再現　衝突判定も簡単

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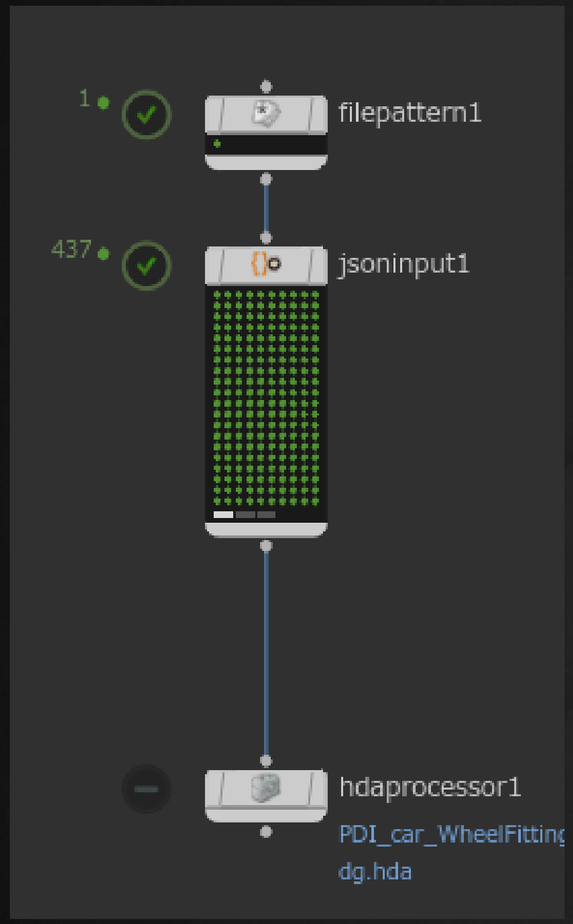
分散処理で更に時間短縮



- 約1,000,000パターンを再現して判定
- Pythonだと処理に2日以上かかった
- PDGを利用した分散処理なら2時間で完了
  - 32プロセス
- USDの読み込み速度も貢献

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まとめ

- 少人数のアーティストだけで大量の高品質なアセットを作る事が出来た
- USD　SOLARIS
  - モデルの参照が自由になった
  - ツールを既存のパイプラインに組み込めた
  - プロシージャルシーングラフ で モデリングからパイプラインまでスムーズに
- プロトタイピングにも優秀
- 分散処理でデバッグも時間短縮
- 新規ツール開発が簡単になった

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Thank You！

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